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ON THE RELATIONS OF THE NIAGARA AND LOWER HELDERBERG  
FORMATIONS, AND THEIR GEOGRAPHICAL DISTRIBUTION IN  
THE UNITED STATES AND CANADA. By JAMES HALL, of  
Albany, N. Y.

IN proceeding to the discussion of this subject, I propose in  
the first place to cite a paper read by Mr. A. H. Worthen at the  
Troy Meeting of the American Association, and published in the  
Proceedings under the following title:

*"Remarks on the Relative Age of the Niagara and so-called  
Lower Helderberg Groups. By A. H. Worthen, of Springfield,  
Illinois."*

"Recent investigations have developed certain facts, bearing  
upon the question of the relative age of the above named groups,

which we desire to present in a brief manner for the consideration of those who are especially interested in stratigraphical geology.

In northern and western Illinois, from the mouth of the Illinois River northward to the Wisconsin line, the Upper Silurian division of the palaeozoic series is represented by buff, gray, or yellowish-gray dolomites, sometimes in remarkably even beds, as at Joliet and Grafton; and at other localities by concretionary masses, with but faint traces of stratification, as at Bridgeport, near Chicago, and at Port Byron and Leclaire, at the head of the Upper Rapids on the Mississippi River. They range in thickness, from seventy-five to three hundred feet, and directly overlie the shales and argillaceous limestones of the Cincinnati group of the Lower Silurian series. These dolomites are quite fossiliferous, and afford many characteristic Niagara species, among which we may mention *Pentamerus oblongus*, *Spirifer radiatus*, *Calymene Blumenbachii*, *Caryoceras ornatus*, *Orthoceras undulatum*, etc. From the Bridgeport locality alone, nearly one hundred species of fossils have been enumerated, a large number of which are specifically identical with those found in the Niagara beds of New York and Canada; and, so far as we are aware, all Western geologists are agreed in considering these dolomites to be the stratigraphical equivalents of the Niagara group of New York.

In southern Illinois we find these dolomites replaced by a series of silicious and argillaceous limestones, forming a group two hundred and fifty feet or more in thickness, which, like the dolomites of northern Illinois, rest directly upon the Cincinnati group, and are immediately succeeded by Devonian strata. At the base of this group of silicious limestones there are some reddish mottled beds, from ten to twenty feet in thickness, that in color bear considerable resemblance to the Medina sandstone of New York; and these mottled limestones pass gradually into the buff and gray silicious beds that constitute the upper and main portion of the group. Fossils are rare in the lower portion of the group here; but the mottled limestones contain some *Orthoceratites*, and joints of large *Crinoidea*, while the middle and upper portions are locally quite fossiliferous, and have afforded many of the characteristic species of the so-called Lower Helderberg group, among which are the following; *Orthis subcarinata*, *O. oblata*, *Celospira subcarinata*, *C. imbricata*, *Spirifer per-lamellosus*, and *Platyceras spirale* of Hall, and *Acidaspis hamatus* of Conrad, together with species closely resembling, if not identical with, *Merista princeps*, *Platyceras pyramidatum*, *P. unguiforme*, *P. incile*, and *P. multistriatum* of Hall.

In the first volume of the 'Report on the Geological Survey of Illinois,' these silicious limestones of the southern portion of the state, and the dolomites of northern Illinois, were regarded as the stratigraphical equivalents of the Niagara group, and were included together as representing a single division of the Upper

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Silurian series; but, subsequently, in a corrected section of the Illinois strata, published in the introduction to the second volume, we were induced, from the dissimilarity of the fossils from the different sections of the state, to regard the silicious limestones of southern Illinois as the representatives of a higher geological horizon, and therefore placed them above the dolomites of the northern part of the State, as the equivalents of the so-called Lower Helderberg group. We are now, however, fully satisfied from a further examination of these Upper Silurian strata, over a more extended region, that our first conclusion was correct, and that these silicious limestones and dolomites represent the same geological horizon, and that the difference in the specific character of their fossil contents is entirely due to the changes in the oceanic conditions under which they were deposited, and not to the different ages of the sediments themselves.

South of the Ohio River, these Upper Silurian strata are found well exposed in Tennessee, in the counties of Wayne, Perry and Decatur, on the Tennessee River, outcropping over a wide area and affording numerous species of fossils in a fine state of preservation. The base of the group here consists of reddish and mottled limestones, very similar to those in southern Illinois, and contain *Orthoceras undulatum*, and joints of large crinoids in great abundance. These red limestones are succeeded by a series of greenish-gray shales, and shaly argillaceous limestones, containing *Caryocerus ornatus*, *Calymene Blumenbachii*, *Sphaeroceras mirus*, *Platyceras Niagarensis*, *Pentamerus oblongus*, *Orthis hybrida*, *O. elegantula*, etc., associated with such Lower Helderberg forms as *Pentamerus galeatus*, *Spirifer per-lamellosus*, *S. macropleura*, *Merista laevis*, *Rhynchonella ventricosus*, and many others, showing that the fossils of these so-called groups are here intermingled through the same strata, confirming what we had already assumed to be true in Illinois, that the Upper Silurian beds of the West constitute but a single group, and consequently that the term Lower Helderberg, as applied to a group distinct from the Niagara, is superfluous. We recollect that, on visiting the locality of these so-called Lower Helderberg limestones in the Schoharie valley some years ago, we observed these limestones resting immediately upon undisputed Lower Silurian beds there, and, in explanation of their occurrence in this apparent abnormal position, we were told that the Niagara group was supposed to have thinned out to the eastward, and that these Lower Helderberg limestones took their place. But is it not quite as probable that there has only been a change in the lithological character of the beds in their eastern extension in New York, resulting there, as in Illinois, in a decided change in the specific character of the fossils which they contain, and that the Upper Silurian beds at Schoharie are the exact equivalents of the Niagara shales and limestones in the western part of the State?

To recapitulate, then, the facts as they are presented in the West; we find that the dolomites of northern Illinois contain only Niagara fossils, and the silicious limestones of the southern portion of the State contain only those considered characteristic of the Lower Helderberg group; while the beds in Tennessee, occupying the same stratigraphical position with the dolomites and the silicious limestones of Illinois, have Niagara and Lower Helderberg fossils intermingled indiscriminately through the strata. Hence we conclude that the so-called Lower Helderberg group has no real existence as a distinct group of Upper Silurian strata, and that the name, being superfluous, should be dropped from the nomenclature of the American rocks."

It is here proposed, in an article of less than three pages, to discard entirely from the geological series and geological nomenclature a well recognized group of strata; well known and clearly defined for more than one thousand miles in extent of country, spreading diagonally over nearly or quite fifteen degrees of latitude, while its undulating and repeated outcrops, owing to anticlinal erosion, add some hundreds of miles more to its known exposures.

The result of tedious and careful field investigations in the working out of hundreds of sections in various parts of the country have been supplemented by the study of large collections of numerous species of fossils, and the final comparison of all these fossils, from the far northeast or the St. Lawrence to Tennessee on the southwest — from the Mississippi valley on the west, from the states of Iowa, Illinois, Wisconsin, the Islands of Lake Huron, and Canada West (or Ontario), together with the more critical study of the rocks and fossils within the limits of the state of New York — are all to be set aside, and a simple *assertion*, unsupported by sections, by fossils, and I may say by a single fact of importance, is to be substituted for all the labors of thirty years.

This assertion comes from a gentleman holding the important and responsible position of State Geologist of Illinois, whose name is associated with so much of the geology and paleontology of the West as to give currency, if not authority and authenticity, to what he may say: — and certainly he ought not, without good reason and authentic data, make such assertions nor put such a paper before the American Association for the Advancement of Science.

But will the geologists of the United States accept this so-called

determination of the identity of the groups of strata known as the NIAGARA and the LOWER HELDERBERG?\*

But Mr. Worthen is not original in this view of the relations of the two groups of strata. He has merely revived an old and discarded error. The same assertion was long ago made in the Geological Reports of Pennsylvania and elsewhere; and was at one time the generally accepted belief among geologists. Professor Rogers, in a paper upon Niagara Falls published, I believe, in 1832, takes this view of the relations of these formations, and includes also the limestone of Black Rock under the same designation. It is not surprising that at that period, when no critical examinations had been made, when we had no knowledge of paleontology as a guide in the more obscure and difficult points, that great surface features should have been taken as guides in the determination of geological formations. It happened in this case that the great escarpment of the Niagara at Lewiston and Queens-town was regarded as the extension of that of the Helderberg and the south side of the Mohawk valley. The limestone of Black Rock, though so far separated from Niagara, was regarded as a part of the same; the features in the West being more subdued, as was supposed.

This in brief was the condition of our knowledge and belief regarding these formations at the beginning of the New York Geological Survey, and for some time afterward.

The one horizon which above all others was at that time regarded as fixed beyond question was that of the salt-bearing strata. This formation, at its base bearing a great thickness of red and mottled shales and marls, succeeded by gray, ash or drab colored beds of similar characters, and finally hard beds of limestone, was regarded as clearly defined from Saltspringville in the Mohawk valley, by way of Syracuse, Montezuma, and thence westward along the base of the Limestone Terrace from Rochester to Lewiston.

Throughout this entire extent salt springs had been discovered, and brines of varying and different qualities were known to exist. No doubt of the nature, age, or identity of the formation, from.

\*Of late years, in certain quarters, it has been only necessary to contradict what has been done in the State of New York, or by persons in her employ, both in geology and paleontology, to have the statement accepted on bare assertion. I might instance examples too numerous to be creditable to the acumen and good sense, to say nothing of the scientific ability, of those who propose or accept such conclusions.

Herkimer county to the Niagara River at Lewiston, had ever been expressed, or, so far as I know, entertained by any one. Now, though this may seem irrelevant to the question before us, it nevertheless lies at the foundation of the error then prevalent, regarding the Niagara and Helderberg formations; and is intimately connected with the greater error now sought to be revived in the paper under consideration.

It was not until the close of the field work of 1838 that this question came before the assembled members constituting the Commission of the New York Geological Survey. The youngest member of that body had asserted, as the result of his investigations, that the rocks at the base of the Niagara Terrace, consisting of red, gray and mottled marls and sandstones, were not the continuation of the salt bearing beds of Onondaga, and elsewhere to the eastward, but a lower formation; that the Niagara limestone, so largely developed at Niagara and Lockport, was not a continuation of the limestone of the Helderberg, but a distinct formation; having its greatest development towards the west, and gradually thinning to the eastward; and that instead of lying above the Salt formation it lay beneath it: that the Salt formation, extending westward from Syracuse, passed to the southward of the Niagara Terrace, and formed the broad belt of flat country to the south of the range, which is so marked a feature from the Genesee River south of Rochester to the Niagara River at Tonawanda; thus separating, by a distance of several miles, the limestone of Niagara and that of Black Rock.

The conditions which originally led to this misapprehension of the relations of the different formations, are, the flat marshy country from the outlets of Seneca and Cayuga lakes to the northward, which has obscured the outcrops, and beyond this, in Wayne county, the great accumulation of drift, which has deeply covered the rock over a large area. If to these we add, that in the earlier geological explorations the line of the Erie canal was that principally travelled, — that the passage from the red and gray marls of the Onondaga region to the red and mottled marls of the Medina Sandstone at Rochester and westward of the Genesee River was through an alluvial or drift country which concealed the underlying rock formations, — the supposed identification of the two formations is not surprising.

That such views should prevail before continued and connected

observations had been carried on, we are prepared to understand; but after nearly forty years of observation, and after the relations of all these rocks have been fully understood for thirty years or more, I submit that it is not worthy of the credit of the American Association to allow such a paper to pass into its publications without serious consideration. Personally I may be interested in this question more than others, since I have published a volume principally upon the paleontology of the formation or group here proposed to be discarded as having no separate or distinct existence in the series; but the science of geology, and those who pursue that science, have an interest in this question far superior to one of mere personality.

*Geological relations and geographical extension of the groups in question.*

Starting from the typical locality of the Niagara group, where we have of the shale and limestone a thickness of something more than two hundred feet, and tracing the outcrop in an easterly direction, we find a very gradual but pretty constant thinning of the beds of the formation, so that at a point one hundred miles east of the Niagara River, it has a thickness of scarcely one hundred feet. Farther east, in Oneida county, the formation is still thinner, and in some places has become in part or almost entirely a brecciated and concretionary mass, with few or no fossils.\*

Going eastward it becomes still further attenuated, but can still be traced both in its physical aspect and outcrop, and by its fossil contents. In the neighborhood of Schoharie, Cobleskill, Cherry valley, etc., it is known as the Coralline Limestone, from its abundance of corals. These are principally identical with the corals of the Niagara group in western New York; and most of the species of Brachiopoda which occur in a condition to be recognized, are similar or identical with Niagara forms, while there are several species quite distinct from those of the Niagara group in the west. The upper limit of *Halysites catenulatus*, so far as known in New York, is in the Niagara limestone; and this fossil occurs in the coralline limestone at Schoharie and at Litchfield in Herkimer county.

I have given in vol. ii, Pal. N. Y., p. 321, more at length my

\*In that part of the state the formation is so insignificant, that it was originally regarded by Mr. Vanuxem as a subordinate member of the Protean or Clinton group; and was only recognized by him as a distinct formation in 1839; after the investigations in the western counties had shown its true relations and importance.



reasons for regarding this coralline limestone as the easterly continuation of the Niagara group; and since the time of that publication, I have made numerous observations upon the relations of the coralline limestone, all of which have tended to confirm the views there expressed. This coralline limestone in its attenuated form may be recognized in the valley of the Hudson River underlying the water-line formation at numerous localities.

Now returning along this line of outcrop to the Niagara River, and following the formation to the northwest, we find it expanding in thickness and area through Canada West to Cabot's Head; appearing in the islands along the eastern and northern side of Lake Huron, and stretching across the peninsula from St. Joseph's River to the outlet of Green Bay; thence occupying the principal part of the peninsula between Green Bay and Lake Michigan, it expands to the southward beyond the southern limits of that lake, and thence trends to the west and northwest through Illinois and Iowa. From the Niagara River westward, the formation is chiefly a magnesian limestone, and in many localities carries an abundance of fossils; both the physical and paleontological evidence leave no doubt as to the age and relations of the formation.

Returning again to the eastward and southward, we find that the anticlinal movement, which elevated the islands in the western part of Lake Erie, has brought up the Niagara formation in the adjacent parts of Ohio, where it is marked by the presence of a greater or less proportion of its characteristic fossils. Here it stretches in a low axis for miles to the south of the lake, and thence spreads and outcrops on either side of the rocks of the Hudson River and Trenton age, which form the central or lower visible portion of the Cincinnati axis.

Following this direction it extends through Kentucky and Tennessee, everywhere carrying its characteristic fossils.

Throughout all this extent, until the formation reaches Tennessee, there is no question raised as to the identity and purity of the Niagara group. Here, it is said that the fossils of the Niagara are mingled with those of the Lower Helderberg group. And again, on the Mississippi River, in Illinois and Missouri, we are told that this mingling of the fossils of the two periods occurs.

But before proceeding to discuss this part of the question, let us for a moment give attention to what is termed the Lower Helderberg group in its typical localities.

In the Helderberg Mountains in Albany county, and in Schoharie along the valley of the Schoharie Creek, and in the Cobleskill valley, we find everywhere a series or group of limestones, of which we distinctly recognize four members; these are known, in the ascending order, as Tentaculite limestone, Lower Pentamerus limestone, Shaly limestone and Upper Pentamerus or Scutella limestone. There is in some places for miles in extent a mass of Stromatopora limestone between the Tentaculite and Lower Pentamerus limestones. These together constitute the Lower Helderberg group, forming in Albany county the base of the Helderberg mountains, and everywhere succeeded by the Oriskany sandstone, Cauda-galli and Schoharie grit and Corniferous limestone, and these, in the summits of the hills by the arenaceous shales of the Hamilton group.

This group of limestones is everywhere characterized by the presence of fossils, often in immense numbers, and specifically, with very few exceptions, quite unlike the fossils of the rocks above or below this horizon. From the Helderbergs, and the valley of the Schoharie, we are able to trace the formation to the westward through the northern part of Otsego, and the southern part of Herkimer and Oneida counties; and, according to Mr. Vanuxem, it is recognized in the eastern part of Onondaga county, by the presence of some of its peculiar fossils. From the Helderberg mountains the group gradually thins to the westward; and in Herkimer county the divisions of the several members are scarcely recognized, the entire mass becoming more completely calcareous but still charged with an abundance of the characteristic fossils of the group. West of Onondaga county the place of the formation is often recognized by a stratum of hard, compact limestone lying beneath the Oriskany sandstone.\* It is quite evident that the force of the entire group diminishes in a westerly direction.

Returning to the point of departure in the Helderbergs, we are able to trace the rocks of this group, in their clearly defined and unmistakable characters, through the eastern counties of New York to the limits of the state of New Jersey. In the northwest part of that state the formation has been distinctly recognized by Professor Cook. The same has been fully described

\*In some former Reports on the Geology of the western counties, this rock is described as worn or eroded previous to the deposition of the Oriskany sandstone.

as the "Limestone formation, No. vi" in the geological survey of Pennsylvania, where it appears in numerous outcrops, and extends thence through the western part of Maryland and through Virginia, along the Appalachian range into Tennessee.

Nowhere throughout this extent of country, as far as Virginia, has any one shown, or attempted to show, the mingling of lower Helderberg and Niagara forms among the fossils. In the large collections which I possess from Maryland and Virginia, I have never observed the least evidence of such mingling; and in Maryland and the adjacent parts of Virginia I can speak from personal observation that the formation is as well defined physically as in any part of New York.

Let us now look to the northeast, where the geological survey of Canada has traced the lower Helderberg formation from Montreal to Gaspé. Having examined large collections of these fossils from the Gaspé region, and others from near Montreal, I have never seen the least indication of a mingling of any other forms with those characteristic of the lower Helderberg.

We have now traced this formation from the forty-third parallel in the state of New York to about the thirty-fifth parallel of latitude in Tennessee, and over the greater part of this extent we have no knowledge of a mingling of the fossils of the two groups or formations. Again, from the vicinity of Montreal to Gaspé, a distance of some seven hundred miles, the formation wherever known carries its characteristic fossils.

This group is likewise recognized in the state of Maine, where it is characterized by numerous well known fossils; and it is not improbable that it may be equally so in the eastern townships of Canada and in the belt of limestones extending through Vermont to the northern part of Massachusetts.

Having thus hastily sketched the ground occupied by these two groups of strata, we may now consider their relations to each other, and the evidence of the mingling of the fossils which would render it necessary to relieve the nomenclature of geology of one of these names, heretofore adopted, and in general use wherever geology is written or spoken.

I will here cite a single sentence from the paper referred to:—

"We recollect that, on visiting the locality of these so-called lower Helderberg limestones in the Schoharie valley some years ago, we observed these limestones resting immediately upon undisputed

lower Silurian beds there; and, in explanation of their occurrence in this apparent abnormal position, we were told that the Niagara group was supposed to have thinned out to the eastward, and that these lower Helderberg limestones took their place."

Fortunately or unfortunately there is no evidence given as to the authority or by whom "*we were told*" that the Niagara group had thinned out to the eastward. In the first place let us inquire as to the fact of the lower Helderberg "limestones resting immediately upon undisputed lower Silurian beds there" or elsewhere. Having been familiar with the Schoharie valley, and having made numerous sections, and explored long lines of outcrop in that valley, in the Cobleskill valley and in the Helderberg, I have never been able to see the lower Helderberg limestones resting upon lower Silurian rocks. On the contrary, the section of strata everywhere shown is the following, as given on the diagram, from the sandstones of the Hudson River group to the Oriskany sandstone:—

		Oriskany sandstone.
Lower Helderberg group.	{	Upper Pentamerus limestone.
		Shaly limestone.
		Lower Pentamerus limestone.
		Tentaculite limestone.
		Water-lime formation.
		Niagara group = Coralline limestone.
		Green shales with Iron pyrites.
Lower Silurian	{	Sandstones and shales of the Hudson River group.

Everywhere the lower member of the lower Helderberg group is unmistakably separated from the sandstones of the lower Silurian age by three distinct and usually well marked members of the series.

Tracing the lower Helderberg formation from this point for sixty miles westward, we have the following section:—

		Oriskany sandstone.
Lower Helderberg group.	{	* Shaly and lower Pentamerus limestones.
		Tentaculite limestone.

\*The upper Pentamerus limestone is not developed as a distinct member of the group.

Water-lime formation.

Onondaga salt group=Red and gray marls.

Niagara group=Coralline limestone.

Clinton group= { Green shales and sandstones with calcareous bands containing interstratified beds of red hematite.

Medina sandstone.

Lower Silurian=Gray and bluish-gray sandstones and shales of the Hudson River group.

Everywhere the lower member of the lower Helderberg group rests upon the water-lime formation; and the latter is always present, separating the former from the coralline or Niagara limestone. At a distance less than one hundred miles farther west, in a line from Seneca or Ontario to Oswego county, we have a section showing the following formations:—

Oriskany sandstone.

Lower Helderberg group { Compact grayish-blue limestones in a band of a few feet in thickness.

Water-lime formation.

Onondaga salt group with salt springs and gypsum beds, more than 1,000 feet in thickness.

Niagara group.

Clinton group.

Medina sandstone.

Hudson River group.

At this point the Niagara group is separated from the continuation of the lower Helderberg group by strata of more than 1,000 feet in thickness.

Everywhere throughout New York the lower Helderberg group is underlaid by the water-lime formation; and the same is true in New Jersey, Pennsylvania, Maryland and Virginia; and everywhere throughout New York and Canada West, and in Wisconsin and Iowa the water-lime formation lies above the Niagara group,

or its representative, the coralline limestone.\* In no case do these two formations come together except where the water-lime formation is absent.

Certainly these formations are widely enough separated to constitute distinct groups over the areas named.

It is suggested in the paper cited that the difference between the fossils of the lower Helderberg group in eastern New York, and those of the Niagara group in the central and western part of the state, is due to "a change in the lithological character of the beds in their eastern extension."

In the western part of the state, the Niagara group is composed of calcareous shales and dolomites. The lower Helderberg group in the eastern part of the state consists, in its lower part, of thick and thin bedded dark or black limestones, with shaly partings, and sometimes with thicker intercalated shaly layers; to these succeed the heavy bedded limestone with *Pentamerus galeatus*, which by the intercalation of shaly matter becomes thin bedded, and passes by almost insensible gradations into the "Shaly Limestone," and finally to a silico-calcareous shale.† The higher member, in many localities, is the thin bedded Upper *Pentamerus* limestone, while at Becraft's mountain and in the Helderberg the upper member is a heavy-bedded encrinural limestone sometimes known as the *Scutella* limestone, from the presence of great numbers of the bases of *Aspidocrinus*. The shales of the Niagara group and their contained bands of limestone, which are the most highly fossiliferous portion of the group in New York, are not dolomitic; and it seems a most extravagant supposition, that the slight lithological differences in the composition of the strata could produce an *entire change* in the fauna; presuming the deposits to be of the same age.

We now come to the consideration of the last paragraph of this remarkable paper, in which we have the following summary:—

"To recapitulate, then, the facts as they are presented in the West; we find that the dolomites of Northern Illinois contain only Niagara fossils, and the siliceous limestones of the southern portion of the State, only those considered characteristic of the lower

\*It is true that over a considerable part of the lake region, the water-lime and Onondaga salt group have been eroded from above the Niagara formation; the place of these softer formations being occupied by the lakes. See Foster and Whitney's Report on the Lake Superior Land District.

†The physical aspect of this portion of the group is preserved in the 'siliceous limestones' of this age in the southwest.

Helderberg group; while the beds in Tennessee, occupying the same stratigraphical position with the dolomites and the siliceous limestones of Illinois, have Niagara and lower Helderberg fossils mingled indiscriminately through the strata. Hence we conclude that the so-called lower Helderberg group has no real existence as a distinct group of upper Silurian strata, and that the name, being superfluous, should be dropped from the nomenclature of the American rocks."

The value of this conclusion will be best appreciated from the fact that in southern Illinois and adjacent parts of Missouri the limestones holding the characteristic Niagara fossils lie beneath those containing the characteristic lower Helderberg fossils; and that we *never* "have Niagara and lower Helderberg fossils indiscriminately mingled through the strata;" unless it be in the débris along the outcrop; and I assert this from my own observation. The same is true of the beds in Tennessee; and though the collections of fossils made on the outcrops and among the débris do contain fossils of the Niagara and lower Helderberg formations mingled together, this is not true of the rocks *in situ*. In this opinion I do not rest alone; and it is only necessary to consult the report of Professor Safford to show that he finds both the rocks and fossils of the lower Helderberg formation distinctly separated from, and lying above, those of the Niagara group.

In some localities Professor Safford asserts that he finds fossils of the two formations mingling *along the line of contact*, which, in the absence of all intervening beds, may very well happen. And this fact, so far from proving the identity or synchronism of the formations, is a very important proof of their distinction in order and in time.\*

In reviewing the facts, and considering the known range and extent of the Niagara and lower Helderberg groups, their close approximation or actual contact over large areas, and their wide separation in other places, we are compelled to the conclusion that there are no two groups, of similar composition, in the entire paleozoic series, which are so clearly distinct and which can be unmistakably traced over so wide an area of country, both in their physical and lithological character, as well as in their contained fossils.

That there are designations among some of the formations

\*We may inquire also whether it may not be inferred that the living organisms of the lower Helderberg period were spread over a sea bottom covered with the dead organisms of the preceding period and became mingled in this manner.

which are superfluous, we are willing to admit; but the proposition to drop from the system one of the most widely distributed formations of the country, whose geological position and relations, and the fossil contents of which are so well known, is scarcely the proper mode of improving "the nomenclature of the American rocks."

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